

Activity report in University of Wisconsin-Milwaukee

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Circumstance

I stayed at Prof. D. Agterberg's group in University of Wisconsin-Milwaukee (UWM) for three month from December 4th 2017 to February 28th 2018. Prof. D. Agterberg is a theorist of condensed matter physics and one of the experts about anisotropic superconductor. He has held visiting professor position at the Institute Solid State Physics in the University of Tokyo that I belong to. He also has an individual relationship with my supervisor Prof. H. Tsunetsugu and kindly accepted my visit. Since my research theme is theory of ferromagnetic superconductor that is one of the anisotropic superconductors, it was the best stay from point of deepening my study on anisotropic superconductor.

Research

In this stay, we studied nodal topology of superconducting monolayer FeSe. Monolayer FeSe has higher T_c than the other iron based superconductors. In order to reveal origin of superconducting state in this material, it is important to investigate character of nodes due to attractive interaction that induces superconductivity. In this study, we used the effective two bands model that describes electronic states near Fermi surface and investigate topological perspective of nodes. The key is that this model includes two type of superconducting pairing: orbitally trivial with usual d-wave anisotropic pairing and orbitally non-trivial with isotropic one. It is expected that both of them and the spin-orbit coupling (SOC) make nodal structure unlike in the case of limit of each pairing. As results, we revealed that nodal points induced by strong SOC have \mathbf{Z} topological charges that strongly reflect orbital degrees of freedom. Moreover, we considered probing the nodeless state through the application of an in-plane magnetic field. We have shown that this field leads to the emergence of topologically protected nodal points and Bogoliubov Fermi surfaces (BFS), providing an experimental test of the nodeless d-wave pairing state. Now, we are writing a paper. Furthermore, we tried identifying the superconducting states in the other materials as a concrete application of BFS but unfortunately time was up. We will continue to study with getting touch with each other.

Life

Milwaukee is the largest city in the state of Wisconsin in the Midwestern United States. It is on Lake Michigan's western shore. During my stay, I experienced severe cold. The highest temperature of the day is often under degrees below zero. Since Milwaukee has a worldwide reputation for beer, I went to some breweries on holidays. I personally worried about the first living by myself before visiting Milwaukee. However, I could lead a healthy lifestyle, thanks to many supports of my friends in UWM and cheap beef. Moreover, since I had a common hobby with Prof. Agterberg, that is soccer, I was very happy to have chances to play soccer with his friends on every Sunday.

In UWM, there are Japanese classes and I sometimes talked with the people who want to get a job in Japan. They have no bias for Japan and Japanese people that many Japanese tend to have. Since they told honestly me good and bad aspects of Japan, they gave me opportunities to re-consider about Japan with fresh feeling.

Acknowledgement

I kindly appreciate that Prof. D. Agterberg accepted my visit and fruitful discussion with him on every day, in addition, his picking up to soccer games on Sundays. I thank Kate Valerius and Dr. Shishidou who supported my stay in Milwaukee and people all I met in Milwaukee who made my Milwaukee life colorful. I also thank my supervisor Prof. Tsunetsugu and my secondary supervisor Prof. Imada who encouraged and supported this stay. Finally, I would like to thank the MERIT program and the MERIT secretariat for assistance on this nice opportunity for this overseas dispatch.



At group meeting